

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Bluestone National Scenic River

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic
Data for Bluestone National Scenic River

blue_geology.pdf

Version: 8/1/2012

Geologic Resources Inventory Map Document for Bluestone National Scenic River

Table of Contents

Geologic Resources Inventory Map Document.....	1
About the NPS Geologic Resources Inventory Program.....	2
Map Unit List.....	4
Map Unit Descriptions.....	5
PNnr - New River Formation, undifferentiated (Pennsylvanian).....	5
PNnrfc - New River Formation, Fire Creek Coal (Pennsylvanian)	5
PNnrp9 - New River Formation, Pocahontas No. 9 Coal (Pennsylvanian).....	5
PNp - Pocahontas Formation, undifferentiated (Pennsylvanian)	5
PNpp6 - Pocahontas Formation, Pocahontas No. 6 Coal (Pennsylvanian)	6
PNpp3 - Pocahontas Formation, Pocahontas No. 3 Coal (Pennsylvanian)	6
Mbs - Bluestone Formation, undifferentiated (Mississippian).....	6
Mbsuc - Bluestone Formation, unnamed conglomeratic sandstone (Mississippian).....	7
Mbsgf - Bluestone Formation, Gladys Fork Sandstone Member (Mississippian)	8
Mbspd - Bluestone Formation, Pride Shale Member (Mississippian)	8
Mpn - Princeton Formation (Mississippian).....	8
Mhu - Upper Hinton Formation (Mississippian).....	9
Mhsg - Hinton Formation, Little Stone Gap (Avis) Member (Mississippian)	9
Mhl - Lower Hinton Formation (Mississippian).....	10
Mhsg - Hinton Formation, Stony Gap Sandstone Member (Mississippian).....	10
Mbf - Bluefield Formation (Mississippian)	10
Mg - Greenbrier Group (Mississippian)	11
Geologic Cross Sections.....	12
GRI Source Map Citations.....	13
Open File Report 1101	13
Report	13
Stratigraphic Column.....	17
Map Symbols	18
Data Point Map	18
Location Map	19
Magnetic Declination	19
References	20
County Geologic Report.....	22
Cores and Coal Samples	23
GRI Digital Data Credits.....	24

Geologic Resources Inventory Map Document



Bluestone National Scenic River, West Virginia

Document to Accompany Digital Geologic-GIS Data

[blue_geology.pdf](#)

Version: 8/1/2012

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Bluestone National Scenic River, West Virginia (BLUE).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

For information about the status of GRI digital geologic-GIS data for a park contact:

Tim Connors
Geologist/GRI Mapping Contact
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 969-2093
fax: (303) 987-6792
email: Tim_Connors@nps.gov

For information about using GRI digital geologic-GIS data contact:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
1201 Oak Ridge Drive, Suite 200
Fort Collins, CO 80525
phone: (970) 491-6655
fax: (970) 225-3597
e-mail: stephanie.omeara@colostate.edu

About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://irma.nps.gov/App/Reference/Search>. To find GRI data for a specific park or parks select the appropriate park

(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

Bruce Heise
Inventory Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 969-2017
fax: (303) 987-6792
email: Bruce_Heise@nps.gov

The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Bluestone National Scenic River, West Virginia (BLUE) are listed below. Units are listed with their assigned unit symbol and unit name (e. g., PNnr - New River Formation, undifferentiated). Units are listed from youngest to oldest. Information about each geologic unit is also presented in the Geologic Unit Information (UNIT) table included with the GRI geology-GIS data.

Geologic Map Units

Paleozoic

Pennsylvanian

Pottsville Group

Approximately 1000 feet (300 meters) of the lower Pottsville Group are exposed in the two-quadrangle area.

PNnr - New River Formation, undifferentiated ([PNnr](#))

PNnrfc - New River Formation, Fire Creek coal ([PNnrfc](#))

PNnrp9 - New River Formation, Pocahontas No. 9 Coal ([PNnrp9](#))

PNp - Pocahontas Formation, undifferentiated ([PNp](#))

PNpp6 - Pocahontas Formation, Pocahontas No. 6 Coal ([PNpp6](#))

PNpp3 - Pocahontas Formation, Pocahontas No. 3 Coal ([PNpp3](#))

Mississippian

Mauch Chunk Group

The Upper Mississippian Mauch Chunk Group in southern West Virginia is subdivided into the Bluefield, Hinton, Princeton [Sandstone] and Bluefield Formations, with a maximum aggregate thickness of approximately 1,050 feet (320 meters), of which approximately 2,100 feet (635 meters) are exposed in the map area.

Mbs - Bluestone Formation, undifferentiated ([Mbs](#))

Mbsuc - Bluestone Formation, unnamed conglomeratic sandstone ([Mbsuc](#))

Mbsgf - Bluestone Formation, Gladys Fork Sandstone Member ([Mbsgf](#))

Mbspd - Bluestone Formation, Pride Shale Member ([Mbspd](#))

Mpn - Princeton Formation ([Mpn](#))

Mhu - Upper Hinton Formation ([Mhu](#))

Mhls - Hinton Formation, Little Stone Gap (Avis) Member ([Mhls](#))

Mhl - Lower Hinton Formation ([Mhl](#))

Mhsg - Hinton Formation, Stony Gap Sandstone Member ([Mhsg](#))

Mbf - Bluefield Formation ([Mbf](#))

Mg - Greenbrier Group ([Mg](#))

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

PNnr - New River Formation, undifferentiated (Pennsylvanian)

360 ft (110 m), partial section

The youngest rocks occurring in the map area are assigned to the New River Formation, a coal-bearing sequence of quartzose and lithic sandstone, siltstone, shale, mudstone, coal, and siderite. Sandstones are mainly very fine- to fine-grained quartz arenites, commonly conglomeratic, and white with tan staining on weathered surfaces. Finer grained lithologies are shades of gray. Pebbles are predominantly quartz with lesser siderite and minor lithic fragments. Lithic sandstones contain varying amounts of metamorphic rock fragments, mica, and various heavy mineral grains. Heterolithic sequences of thinly interbedded or laminated sandstone, siltstone and shale layers often intergrade between lenticular and flaser bedding, occasionally with low-diversity trace fossil assemblages. Mudstones are internally massive, often arenaceous, and generally occur below coal beds (seatrocks) or are laterally correlative to absent coal beds. Siderite occurs as nodules and layers in marine-influenced mudrock sequences. Coal beds are generally thin and non-economic. A massive quartz arenite, the Pineville Sandstone Member, occurs in the map area but poor exposures precluded mapping the unit. Named coal beds include the Pocahontas 8 and 9 (PC9), Little Fire Creek, Fire Creek (FCK), and Beckley. Due to poor exposures and the thin, discontinuous nature of these coal beds in the map area, only the Pocahontas No. 9 and Fire Creek coal bed outcrops are shown and are dotted on the map to indicate their inferred position. Plant fossils are common throughout the formation, ranging from well-preserved specimens to poorly-preserved comminuted plant debris draping beds. Lycopoid rootlets are abundant throughout. No invertebrate fossils were noted while mapping, although Henry and Gordon (1979) noted the uncommon occurrence of margin-marine bivalves from some levels, notably the roof shales of the Fire Creek coal bed. Only the lower 360 feet (110 meters) of the New River Formation are present in the map area; the upper part being removed by erosion. The formation's basal contact is arbitrarily placed at the base of the Pocahontas No. 8 coal bed (Englund, 1979). However, this coal has been removed by erosion in the map area; thus necessitating the placement of the basal formation contact at the base of the Pineville Sandstone Member. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

***Note: The following coal beds are mapped as linear features within the GRI GIS data for this park.

PNnrfc - New River Formation, Fire Creek Coal (Pennsylvanian)

See above for lithologic descriptions.

PNnrp9 - New River Formation, Pocahontas No. 9 Coal (Pennsylvanian)

See above for lithologic descriptions.

PNp - Pocahontas Formation, undifferentiated (Pennsylvanian)

620 ft (190 m)

The Pocahontas Formation is a coal-bearing sequence of sandstone, siltstone, shale, mudstone, and siderite. Sandstones are mainly fine- to coarse-grained, micaceous, light gray, and trough-crossbedded lithic arenites. White-weathering feldspars have been noted (Englund, 1979). Sandstones often contain thin shale streaks, coal fragments, and ironstone (siderite, limonite, goethite) concretions. Siltstones and shales are light- to dark-gray, black, often arenaceous, carbonaceous in places, fissile, and platy.

Mudstone and claystone occur mainly as medium gray seatrocks with carbonized lycopsid rootlets. Plant fossils are common throughout the formation. Non-marine bivalves have been reported from several beds in surrounding areas (Henry and Gordon, 1979; Englund and Randall, 1981; Meisner, 1981) but were not observed within the mapped area. Named coal beds include the Pocahontas Nos. 1, 2, 3, 4, 5, 6, and 7, but exposures are poor. The Pocahontas No. 6 (PC6) and Pocahontas No. 3 (PC3) coal beds are the most laterally continuous Pocahontas Formation coals in the adjacent area and were the only coal beds included on the map. These coals are thinner and less continuous in the map area, and therefore, their outcrops were estimated from adjacent areas and are dotted on the map to show their inferred position. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

PNpp6 - Pocahontas Formation, Pocahontas No. 6 Coal (Pennsylvanian)

Named coal beds include the Pocahontas Nos. 1, 2, 3, 4, 5, 6, and 7, but exposures are poor. The Pocahontas No. 6 (PC6) and Pocahontas No. 3 (PC3) coal beds are the most laterally continuous Pocahontas Formation coals in the adjacent area and were the only coal beds included on the map. These coals are thinner and less continuous in the map area, and therefore, their outcrops were estimated from adjacent areas and are dotted on the map to show their inferred position. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

PNpp3 - Pocahontas Formation, Pocahontas No. 3 Coal (Pennsylvanian)

Named coal beds include the Pocahontas Nos. 1, 2, 3, 4, 5, 6, and 7, but exposures are poor. The Pocahontas No. 6 (PC6) and Pocahontas No. 3 (PC3) coal beds are the most laterally continuous Pocahontas Formation coals in the adjacent area and were the only coal beds included on the map. These coals are thinner and less continuous in the map area, and therefore, their outcrops were estimated from adjacent areas and are dotted on the map to show their inferred position. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mbs - Bluestone Formation, undifferentiated (Mississippian)

500 to 750 ft (150 to 230 m)

The Bluestone Formation is up to 750 feet (230 meters) thick in the map area and is notable due to its conspicuous red color. Mudstone, shale, siltstone, and sandstone are the main rock types with discontinuous beds of coalesced authigenic limestone and siderite nodules. A few thin, discontinuous, impure coal beds are present. Bluestone marine zones contain a typical Upper Mississippian (Chesterian) fauna of brachiopods, bryozoans, corals, bivalves, gastropods, ostracodes, trilobites, pelmatozoans and cephalopods (Reger, 1926; Cooper, 1948, 1961; Henry and Gordon, 1979, 1992; Hoare, 1993). The Bluestone is subdivided into the marine Pride Shale Member, the Glady Fork Sandstone Member, the informal gray and red members of Englund (1968), the marine Bramwell Member, and the informal upper member of Englund (1968). The Pride Shale and the Glady Fork Sandstone were the only continuous, recognizable Bluestone units mapped. A discontinuous conglomerate was mapped in the upper Bluestone and used as a marker bed. The informal upper member of Englund (1968) is not always present due to erosion associated with the mid-Carboniferous Eustatic Event (Beuthin and Neal, 1998; Blake and Beuthin, 2008).

The informal upper member of Englund (1968) overlies the Bramwell Member and contains the youngest Mississippian rocks in the Central Appalachian Basin. Where present, the upper member consists of stacked red, calcareous mudstones (vertisols), poorly-laminated grayish-green alluvial plain mudrocks, and thin sandstones. Organic-rich layers (possible O-horizons) cap some paleosols, but discontinuous

coal zones are uncommon. White-gray claystones (gleysols) underlie organic-rich horizons (histosols, O horizons). Beuthin (1997) demonstrated that a 3 feet (9 meter) thick, well-developed complex of stacked paleoverisols, the Green Valley Paleosol Complex (GVPC), represented soil formation on a Late Mississippian and Early Pennsylvanian landscape. The upper member contains the stratigraphically highest red beds in the study area. Well-exposed sections are uncommon due to erosion during the mid-Carboniferous eustatic event and modern weathering of incompetent, clay-rich strata. The upper member is unconformably overlain by the Lower Pennsylvanian Pocahontas Formation (Blake and Beuthin, 2008).

The Bramwell Member is a coarsening-upward unit consisting of green to gray shale, calcareous siltstone, and ripple-bedded sandstone. Bioturbation is common but beds are rarely homogenized. The Bramwell attains a maximum thickness of approximately 11 feet (35 meters) and depositionally thins to the north and west (Beuthin, 1997). Black, carbonaceous shale containing ostracodes and *Lingula* occurs at the base of the member and is exposed along Interstate 77. This suggests deepening during a gradual transgression. The Bramwell contains a diverse shelly fauna that is often concentrated as pavements. The fauna is dominated by brachiopods and bivalves, but bryozoans, crinoids, blastoids, bivalves, trilobites, cephalopods and corals have been noted (Beuthin, 1997), although exposures in the study area are less fossiliferous. The Bramwell is poorly exposed within the map area, but has been identified in surrounding areas.

A lenticular unnamed conglomeratic sandstone (Mbsuc) 0 to 100 feet (0 to 30 meters) thick caps ridges in the eastern portion of the Flat Top quadrangle. This medium- to coarse-grained sandstone may be confused with the overlying Pennsylvanian sandstones. Angular to subangular pebbles 1 inch (2.5 centimeters) in diameter occur in a basal lag up to 2 feet (0.6 meter) thick. The sandstone is crossbedded but may appear massive on weathered surfaces. Ironstone clasts weather out leaving a pockmarked appearance.

The middle part of the Bluestone Formation has been informally subdivided into the red and gray members that are dominated by mudstones (paleoverisols; Blake and Beuthin, 2008) (red above, and gray below). The upper part of this interval is conspicuously red. Subordinate lithologies include sandstones, siltstone, shales, and limestones. A few discontinuous, impure coal beds are present in the red and gray members and a widespread coaly zone presages the overlying marine Bramwell Member transgression.

The informal gray member is gray to green-gray and contains several ostracode and myalinid bivalve-bearing, black carbonaceous shales and impure limestone beds. Lycopsid rootlets are common and evidence of paleopedogenesis is widespread. Red beds are uncommon and the top of this unit is arbitrarily placed where red beds become dominant. This unit likely correlates with the Pipestone Shale of Reger (1926). *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mbsuc - Bluestone Formation, unnamed conglomeratic sandstone (Mississippian)

0 to 100 feet (0 to 30 meters)

A lenticular unnamed conglomeratic sandstone (Mbsuc) 0 to 100 feet (0 to 30 meters) thick caps ridges in the eastern portion of the Flat Top quadrangle. This medium- to coarse-grained sandstone may be confused with the overlying Pennsylvanian sandstones. Angular to subangular pebbles 1 inch (2.5 centimeters) in diameter occur in a basal lag up to 2 feet (0.6 meter) thick. The sandstone is crossbedded but may appear massive on weathered surfaces. Ironstone clasts weather out leaving a pockmarked appearance.

GRI Source Map ID 75598 ([Open File Report 1101](#)).

Mbsgf - Bluestone Formation, Gladly Fork Sandstone Member (Mississippian)

0 to 40 feet (0 to 12 m)

This unit ranges from silty, ripple-bedded sandstone to coarse, conglomeratic sublitharenite and is most commonly a light gray to light brown, fine- to coarse-grained, thin-bedded to trough-crossbedded sandstone. It weathers light-brown to brown, is slightly micaceous, contains carbonaceous films and flakes, and locally forms cliffs. The Gladly Fork Sandstone is present throughout most of the map area except in the southwestern portion of the Flat Top quadrangle. This unit is sometimes confused with the Pipestem Shale of Reger (1926), a cross-laminated, fine-grained sandstone and siltstone found at the top of the Pride Shale Member. This relationship can best be observed in the vicinity of McKeever Lodge at Pipestem State Park. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mbspd - Bluestone Formation, Pride Shale Member (Mississippian)

160 to 240 ft (48 to 72 m)

The basal member of the Bluestone Formation is the dark gray, lithologically distinct Pride Shale. In the study area the Pride exhibits a distinctive corrugated appearance on weathered surfaces from a rhythmic alternation of shale, siltstone and sandstone laminae due to reported multiple hierarchies of tidal cyclicity (Miller and Eriksson, 1997). A ravinement (transgressive) surface erosionally separates coastal plain and estuarine beds from overlying marine beds, and in some areas, Princeton paleovalley interfluvies. A 0 to 12-inch (0 to 30-centimeter) thick basal transgressive lag (ravinement bed) consisting of an arenaceous mudstone overlies the ravinement surface. Extensive bioturbation homogenized the lag and siderite cementation is locally pervasive. Trilobites, articulate and inarticulate brachiopods, bivalves and gastropods have been identified in the lag (B.M. Blake, Jr., personal communication, December 2011). A finely-laminated, dark gray to black, clay-rich, carbonaceous shale containing, ellipsoidal limestone concretions, bivalves and ostracodes overlies the lag. This shale bed exhibits a characteristic high gamma ray log signature in the subsurface (Schalla, 1984; Wrightstone, 1984, 1985), which is interpreted as a condensed section that marks the maximum extent of the Pride transgression. The shales of the condensed section grade upward into the more typical laminated regressive facies containing rare bivalves and the inarticulate brachiopod *Lingula*. In northern parts of the study area, a full marine fauna is present (B.M. Blake, Jr., personal communication, December 2011). Where not truncated by the Gladly Fork Sandstone of Reger (1926), the Pride grades upward into poorly-drained coastal plain sediments informally named the gray member by Englund (1968) or the Pipestem Shale after Reger (1926). Where arenaceous, these beds have been misidentified as the overlying Gladly Fork Sandstone. The entire Pride Shale sequence is well exposed in roadcuts at the Camp Creek Exit on Interstate 77. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mpn - Princeton Formation (Mississippian)

0 to 100 ft (0 to 30 m)

The Princeton Formation (Miller and Eriksson, 1997) represents a conceptual expansion of the original "type" Princeton Sandstone (Campbell, 1896) named for exposures around Princeton, West Virginia. The Princeton Formation [Sandstone] is a fine- to medium-grained, quartzose sandstone to quartz arenite. In outcrop, the Princeton Sandstone is conspicuous in containing extrabasinal quartz pebbles and intrabasinally derived polymictic conglomerate beds. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mhu - Upper Hinton Formation (Mississippian)

Hinton Formation, 800 to 1350 ft (244 to 592 m)

Blake and Beuthin (2004) informally subdivided the Hinton Formation into upper and lower divisions for mapping and discussion purposes, a scheme adopted herein.

Upper Hinton, 450 ft (135 m)

The upper Hinton Formation (after Beuthin and Blake, 2004) is up to 450 feet (135 meters) thick and extends from the top of Avis Limestone of Reger (1926) to the base of the Pride Shale Member of the overlying Bluestone Formation. The upper Hinton comprises a variable succession of mudstone, sandstone, and limestone with limited occurrences of coal. Autogenic limestone, siderite and hematite nodules are common in some beds. Mudstones are mainly red and green, less commonly gray-green. Sandstones are generally very fine- to medium-grained and lithic; quartz arenites are rare. Conglomeratic lenses within sandstones consist of intrabasinally-derived clasts of limestone, siderite and mudrocks. Sandstones in the area around Pipestem, Dunns, and Streeter are often thick enough to resemble the Princeton and may be a source of confusion during mapping. In contrast to past reports (Reger, 1926; Englund, 1968; Miller and Eriksson, 2000), geologic mapping at 1:24,000 scale (Beuthin et al., 2000; Blake et al., 2000, 2001; Beuthin and Blake, 2001, 2002a; Blake and Beuthin, 2002) demonstrated that upper Hinton sandstones are limited in lateral continuity and should not be afforded member rank. Limestones include marine shell beds, thin bivalve-dominated bioherms, and argillaceous calcareous mudstones with ostracodes, myalinid bivalves, fish scales and vertebrate bone fragments. Calcareous glaebules, locally coalesced into nodular beds (caliches), occur within some red mudstones. Evidence of pedogenesis is widespread in upper Hinton strata. Pedogenic features (Mack et al., 1993; Beuthin and Blake, 2002b) in red mudstones include shrink-swell structures, pedogenic slickensides, clastic dikes filling desiccation cracks, reduction features (burial gleys; drab-haloed root traces) and caliches (vertisols and calcisols). Coal beds (histosols) are generally thin (centimeter-scale) and impure, grading laterally and vertically into carbonaceous shale (Beuthin and Blake, 2002b, 2004). Beuthin and Blake (2004) suggested these coal beds formed as peat accumulated in muck puddles as water tables rose prior to the cyclic marine transgressions. Carbonaceous beds (histosols) are associated commonly with white-gray mudstones (gleyols) that contain carbonized lycopsid roots and pyrite nodules (Beeler, 1999; Miller and Eriksson, 1999; Beuthin and Blake, 2002b, 2004; B.M. Blake, Jr., West Virginia Geological and Economic Survey, personal communication, December 2011). The two regionally-extensive marine members present in the upper Hinton, the Fivemile and Eads Mill members (Beuthin and Blake, 2004), have been attributed to glacioeustatic transgressions (Miller and Eriksson, 2000; Beuthin and Blake, 2004). These marine zones contain a typical Chesterian fauna of brachiopods, bryozoans, corals, bivalves, gastropods, ostracodes, trilobites, pelmatozoans and cephalopods (Reger, 1926; Cooper, 1948, 1961; Henry and Gordon, 1979, 1992). While these units assist in identifying stratigraphic position, they were not exposed well enough for consistent mapping in the study area. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

MhlsG - Hinton Formation, Little Stone Gap (Avis) Member (Mississippian)

50 to 65 ft (15 to 20 m)

A widespread and currently unnamed marine unit comprised of the Paynes Branch Sandstone, Lower Avis Shale, Avis Limestone (equivalent to the Little Stone Gap Member), Upper Avis Shale and Upper Avis Sandstone (Neal Sandstone of Englund, 1968) (after Reger, 1926) occurs near the middle of the Hinton Formation throughout the mapping area. These units are currently under investigation and a formal nomenclature will be advanced in the near future (B.M. Blake, Jr., West Virginia Geological and Economic Survey, personal communication, December 2011). The member consists of a basal, lenticular, laminated to thinly bedded, highly bioturbated, very fine- to fine-grained sandstone (Paynes Branch Sandstone of Reger 1926) overlain by discontinuous calcareous, marine invertebrate-bearing shale beds (Lower Avis Shale of Reger, 1926) that intergrade laterally and vertically with limestone. The

most distinctive and mappable part of the unnamed member is the Avis Limestone of Reger (1926; Little Stone Gap Member) which has been identified throughout the central Appalachian region. The Avis Limestone is predominately micritic and argillaceous and contains a typical Chesterian fauna of bryozoans, corals, bivalves, gastropods, ostracodes, trilobites, pelmatozoans and cephalopods. Stromatolitic beds were identified at the base of the Avis Limestone in Pipestem Creek south of the falls (B.M. Blake, Jr., West Virginia Geological and Economic Survey, personal communication, December 2011). Bedding varies from laminated to massive. The more argillaceous beds appear nodular on weathered surfaces. Minor karstic weathering is common and small caves were noted along Indian Ridge. The Upper Avis Shale of Reger (1926) is a heterolithic sequence of shales, mudstones, siltstones, and very fine sandstones exhibiting minor bioturbation (burrowing and rooting) and locally containing limited diversity bivalve and ostracode assemblage. Plant fossils are also common locally. Limestone beds ranging in thickness from inches to feet (centimeter to meters) and containing a diverse marine invertebrate assemblage are not uncommon. Dolomitic limestone beds generally occur within the upper Avis shale and rarely contain identifiable fossils. The Upper Avis Sandstone of Reger (1926) was not noted in the study area. Because of its distinct nature and regional distribution, the Avis Limestone of Reger (1926) is an important marker horizon for the eastern portion of the map area where it is the most consistently identifiable bed. As a result, the Avis Limestone was used as a structural datum to assist in the construction of contacts in areas of poor exposure. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mhl - Lower Hinton Formation (Mississippian)

700 ft (210 m)

According to Beuthin and Blake (2004) the Lower Hinton Formation is lithologically similar to the upper Hinton, but without the regionally identifiable marine units. It is a variable succession of mudstone, sandstone, and limestone with limited occurrences of coal. Autogenic limestone, siderite and hematite nodules are common in some beds. Mudstones are mainly red and green, less commonly gray-green. Sandstones are generally brownish violet to grayish green, very fine- to medium-grained, well-sorted and lithic; quartz arenites are rare. Sandstones display trough crossbeds, planar crossbeds, and ripple-scale cross-lamination. Conglomeratic lenses within sandstones consist of intrabasally-derived clasts of limestone, siderite and mudrocks. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mhsg - Hinton Formation, Stony Gap Sandstone Member (Mississippian)

40 ft (12 m)

The Stony Gap Sandstone, informally called the Upper Maxon Sand by drillers, is the basal member of the Hinton Formation. It is mainly a white, fine- to medium-grained quartz arenite although it changes locally to a light gray, fine-grained, lithic arenite. The unit is typically crossbedded, with both trough and planar crossbeds present. The Stony Gap is highly variable across the map area, ranging from thick, cliff-forming sandstones, to thinner, flaggy sandstones. The Stony Gap is sometimes subdivided into upper and lower members separated by a conglomerate zone. The basal part of the unit often has log clasts while the upper part is ripple to trough cross laminated. The basal contact is sharp but variable, demonstrating erosion (potential valley incisement), and resulting in an unconformable contact with the underlying Bluestone Formation. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mbf - Bluefield Formation (Mississippian)

120 ft (36 m), partial section

The upper 120 feet (36 meters) of the Bluefield Formation is poorly exposed in the eastern map area

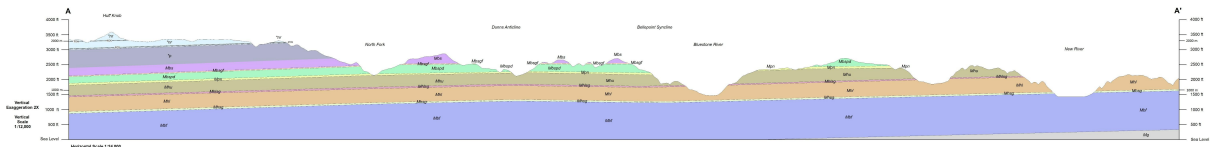
along the New River Gorge. This part of the formation comprises gray calcareous shales and blocky reddish mudstones. An unnamed, fossiliferous limestone occurs in this area, often directly underlying the Stony Gap Sandstone. The basal contact with the underlying Greenbrier Group is not exposed. Reger (1926) reported a total thickness of up to 1350 feet (412 meters) for the Bluefield Formation. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Mg - Greenbrier Group (Mississippian)

Shown in cross-section only. No description provided. *GRI Source Map ID 75598* ([Open File Report 1101](#)).

Geologic Cross Sections

The geologic cross section present in the GRI digital geologic-GIS data produced for Bluestone National Scenic River, West Virginia (BLUE) is presented below. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (when viewing the digital format of this document).



Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

GRI Source Map Citations

The GRI digital geologic-GIS map for Bluestone National Scenic River, West Virginia (BLUE) was compiled from the following source.

Matchen, David L., Joseph L. Allen, Robert C. Peck, and David Mercier, (Digital Cartography and Map Compilation by Sarah E. Gooding and Paula J. Hunt), 2011, Bedrock Geologic Map of the Bluestone National Scenic River, Flat Top and Pipestem 7.5' Quadrangles, WV, WVGES, Open-File Report 1101, 1: 24000 (GRI Source Map 75598) ([Open File Report 1101](#)).

Additional information pertaining to each source map is also presented in the Source Map Information (MAP) table included with the GRI geology-GIS data.

Open File Report 1101

Matchen, David L., Joseph L. Allen, Robert L. Peck, and David Mercier, (Digital Cartography and Map Compilation by Sarah E. Gooding and Paula J. Hunt), 2011, Bedrock Geologic Map of the Bluestone National Scenic River, Flat Top and Pipestem 7.5' Quadrangles, WV, WVGES, Open-File Report 1101, 1: 24000 (GRI Source Map 75598)

Report

David L. Matchen¹
Joseph L. Allen¹
Robert L. Peck¹
David Mercier¹

Digital Cartography and Map Compilation by Sarah E. Gooding² and Paula J. Hunt²

¹ Concord University
Department of Geology and Physical Sciences
401B Science Hall
Athens, West Virginia 24712

² West Virginia Geological and Economic Survey
1 Mont Chateau Road
Morgantown, West Virginia 26508-8079
Phone: (304) 594-2331

Suggested Citation:

Matchen, David L., Joseph L. Allen, Robert L. Peck, and David Mercier, (Digital Cartography and Map Compilation by Sarah E. Gooding and Paula J. Hunt), 2011, Bedrock Geologic Map of the Bluestone National Scenic River, Flat Top and Pipestem 7.5' Quadrangles, West Virginia, West Virginia Geological and Economic Survey, Open-File Report 1101, 1: 24000 scale.

Introduction

This map of the bedrock geology in and around the National Park Service's Bluestone National Scenic River covers the Flat Top and Pipestem 7½-minute United States Geological Survey topographic quadrangles in Summers, Mercer, and Raleigh counties, West Virginia. Surficial deposits were also

mapped within the National Park Service property boundary in these quadrangles as part of a separate publication. The study area is located in the Kanawha River drainage basin in the relatively horizontal to gently folded rocks of the Appalachian Plateau physiographic province.

According to common lore, the Native American name for the Bluestone River translates into “Big Stone River.” The river ostensibly received its present name from the blue-colored limestone in the river bed. The spectacular scenery of the Bluestone River Gorge is the result of erosion through the Princeton and Glady Fork Sandstones. The National Park Service has protected 10.5 miles (17 km) of the Bluestone River upstream of the New River and Bluestone Lake. Bluestone State Park, Pipestem Resort State Park, and a portion of Camp Creek State Park are also located in the map area.

Adjacent Bedrock Mapping

Quadrangles previously mapped by the West Virginia Geological and Economic Survey include Athens and Leron (Beuthin and Blake, 2001; 2002a), located south of the present map area. Bedrock of the Shady Spring quadrangle, located north of the Flat Top quadrangle, was mapped by the United States Geological Survey (Meissner, 1981). The Pineville Sandstone Member of the New River Formation was mapped separately by Meissner (1981) in the Shady Spring quadrangle, but was not separated from the New River Formation on the Flat Top quadrangle due to lack of exposure. In the Athens and Leron quadrangles, Beuthin and Blake (2001; 2002a) mapped members that were too poorly exposed in the Bluestone map area to break out as separate map units. Likewise, some of the units on the Bluestone bedrock map were not mapped separately on the Athens and Leron quadrangles.

Overview of Stratigraphy

Rock units exposed at the surface in the study area include the Upper Mississippian Mauch Chunk Group, which is subdivided into (ascending) the Bluefield and Hinton formations, the Princeton Formation (Princeton Sandstone), and the Bluestone Formation. Pennsylvanian rock units exposed include the Pocahontas Formation and the lower New River Formation (Pottsville Group). In general, bedrock consists of intercalated sandstones, siltstones, shales, mudstones, limestones, and coals. These units are shown on the stratigraphic column along with their estimated thicknesses in the map area. Except for resistant sandstones, rock exposures are limited by soil cover, colluvium, and vegetation. Where concealed, contacts between rock units were inferred from cores, gas well records, aerial photography, digital elevation models, and data from adjacent areas.

The oldest rocks exposed in the study area are the shales, limestone, and mudstones of the upper 120 feet (36 meters) of the Bluefield Formation observed along the New River in the Pipestem quadrangle. The base of the Bluefield Formation is not exposed in the map area.

The youngest rocks exposed in the map area belong to the lower New River Formation and cap the plateaus in the northwestern portion of the Flat Top quadrangle. The thickest remnant of the New River Formation is poorly exposed on Huff Knob, where up to 360 feet (110 meters) of coals, shales, and sandstones are present. Although thick quartz arenites were observed across the Flat Top area, the prominent and continuous sandstones mapped farther to the north are less discontinuous in the map area. Where these sandstones were observed they typically cap isolated ridge crests and were mapped as separate units. An example of this is an unnamed quartz conglomerate in the upper Bluestone Formation along Ellison Ridge in the Flat Top quadrangle. Mapping this unit separately provided stratigraphic control that would otherwise have been lacking in this part of the map area.

Structural Geology and Tectonics

The general strike of rocks in the Appalachian Plateau is northeast-southwest, at approximately N30°E. The original geologic maps of the area (Krebs and Teets, 1916; Reger, 1926) included a relatively large anticline, the Dunns Anticline, plunging to the southwest around Dunns in the Flat Top quadrangle. Preliminary field mapping for this study indicated that this structure was not as prominent as earlier maps suggested. Because the units dip so gently, a structure contour map was constructed on the

base of the persistent and identifiable Princeton Sandstone. The structure map, which uses observed outcrop data and is supplemented in the western map area by limited gas-well data, indicates that the Dunns Anticline and Bellepoint Syncline are present, but very subtle.

Coal Resources, Building Materials, and Gas Resources

New River and Pocahontas coal beds are generally thin, laterally discontinuous, and have no documented commercial mining in the study area (West Virginia Geological and Economic Survey, 2011a, 2011b, and 2011c). The regionally important Pocahontas Formation coal horizons present in the map area include the Pocahontas No. 3 and the Pocahontas No. 6 coals. The New River Formation coal beds mapped in the study area are the Pocahontas No. 9 and Fire Creek coals.

Reger (1926) reported a quarry in the Avis (Little Stone Gap) limestone between the Bluestone River and the New River on the Pipestem quadrangle, but in general, quarrying of this unit was on a small scale. A quarry or “gravel pit” is shown on the Flat Top Mountain quadrangle in the New River Formation southeast of Flat Top Lake.

Oil and gas wells have been drilled in the study area since the late 1800s, with most drilling activity occurring since the 1940s. Successful natural gas wells were drilled in the western portion of the map area in the Flat Top quadrangle, with a handful of less successful wildcat wells attempted in the eastern portion of the map area in the Pipestem quadrangle. Three named gas fields are present in the study area: Mabscott, Rhodell, and Hinton. Most of the successful wells were completed in Mississippian rocks, with a few producing wells completed in Upper Devonian units (Cardwell and Avary, 1982; West Virginia Geological and Economic Survey, 2011d). The oil and natural gas potential of deeper strata was not assessed for the Bluestone bedrock map.

Recreation

Many recreation opportunities are available in the area. The National Park Service’s Bluestone National Scenic River, the U.S. Army Corps of Engineers’ Bluestone Lake, and three West Virginia State Parks (Bluestone, Pipestem Resort, and Camp Creek) are popular destinations for whitewater paddling, rock climbing, motor boating, fishing, camping, hunting, hiking, mountain biking, and skiing (West Virginia Division of Natural Resources, 2011a, 2011b, 2011c, and 2011d). The 10.5-mile (17 km) gorge between the Bluestone and Pipestem Resort State Parks is preserved by the National Park Service as the Bluestone National Scenic River (NPS, 2011).

The two state parks are connected by a trail along the river called the Bluestone Turnpike. Bluestone State Park, located near the confluence of the New and Bluestone Rivers, offers views of the lower Hinton Formation, including ledges and cliffs of the Stony Gap Sandstone. Within Pipestem State Park, the Glady Fork Sandstone forms the cliffs at the top of the gorge. Downstream toward the confluence with the New River, the Princeton Sandstone forms the rim of the gorge. Pipestem State Park’s aerial tramway provides riders a chance to descend rapidly from the resistant Princeton Sandstone at the edge of the gorge down to the softer limestone and mudstone of the Hinton Formation at the bottom of the gorge. Land along the shore of Bluestone Lake is managed as Bluestone Wildlife Management Area, a popular area for hunting in the region. The southwest corner of the Flat Top quadrangle includes portions of Camp Creek State Park and Forest. The park and forest preserve land at the base of Flat Top Mountain, and include two scenic waterfalls developed on the Princeton Sandstone.

Acknowledgements

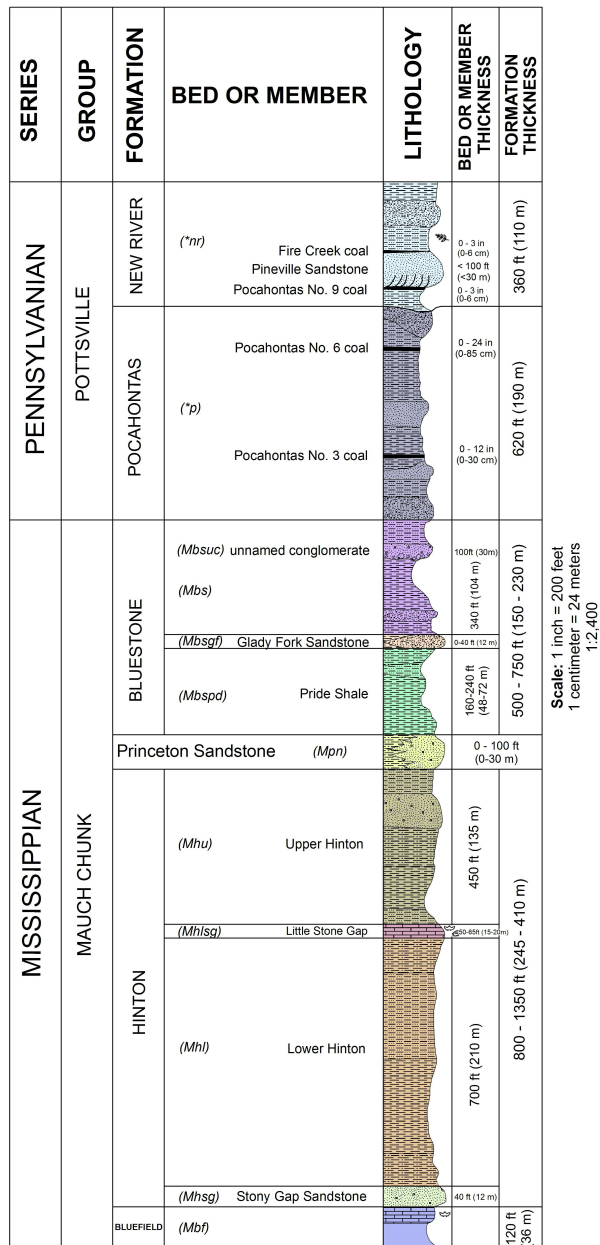
Bedrock was mapped by David L. Matchen, Joseph L. Allen, Robert C. Peck, and David Mercier of Concord University in 2010 and 2011. Concord University geoscience students Kenneth Stanley and Aaron Owens provided GIS and field assistance. West Virginia Geological and Economic Survey (WVGES) cartographer and geologist Sarah Gooding was assisted by geologists Paula Hunt and Philip Dinterman in producing the final map, map text, cross section, and geodatabase. Andy Steele of the National Park Service provided technical and field support. Mitch Blake of WVGES provided guidance,

internal agency map review, and extensive unit-description editing. Ronald McDowell of WVGES also provided internal agency map review. Thomas Whitfield and William Kochanov of the Pennsylvania Department of Environmental Resources Bureau of Topographic and Geologic Survey, and Jaime Toro of West Virginia University provided external map and geodatabase review. All reviewers are thanked for their time; their helpful suggestions made this a much better map. The authors acknowledge the hard work of the WVGES geologists who came before them and laid the foundation that is continually being built upon and refined. Most of the funding for this mapping project was provided by the National Park Service under Contract #C236009073, with remaining funds provided by the West Virginia Geological and Economic Survey.

Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

Stratigraphic Column

This stratigraphic column graphic is at a high resolution and can be viewed in more detail by zooming in (when viewing the digital format of this document).



Lithology Symbols

Coal	Limestone
Mudstone	Fine-grained Sandstone
Shale	Medium-grained Sandstone
Sandy Shale	Fine- to Coarse-grained Sandstone
Silty Shale	Conglomeratic Sandstone

Fossils

Bivalve
Brachiopod
Plant

Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

Map Symbols

———— Contact, Certain

----- Contact, Approximately Located

----- Contact, Inferred

———— A - A' Cross Section Location Line

.....PC6..... Coal Bed, Inferred

Coal Beds:

FCK: Fire Creek Coal bed

PC9: Pocahontas No. 9 Coal bed

PC6: Pocahontas No. 6 Coal bed

PC3: Pocahontas No. 3 Coal bed

Structure:

—2400— Princeton Sandstone Structure Contour, Location Certain

---1200--- Princeton Sandstone Structure Contour, Location Approximate

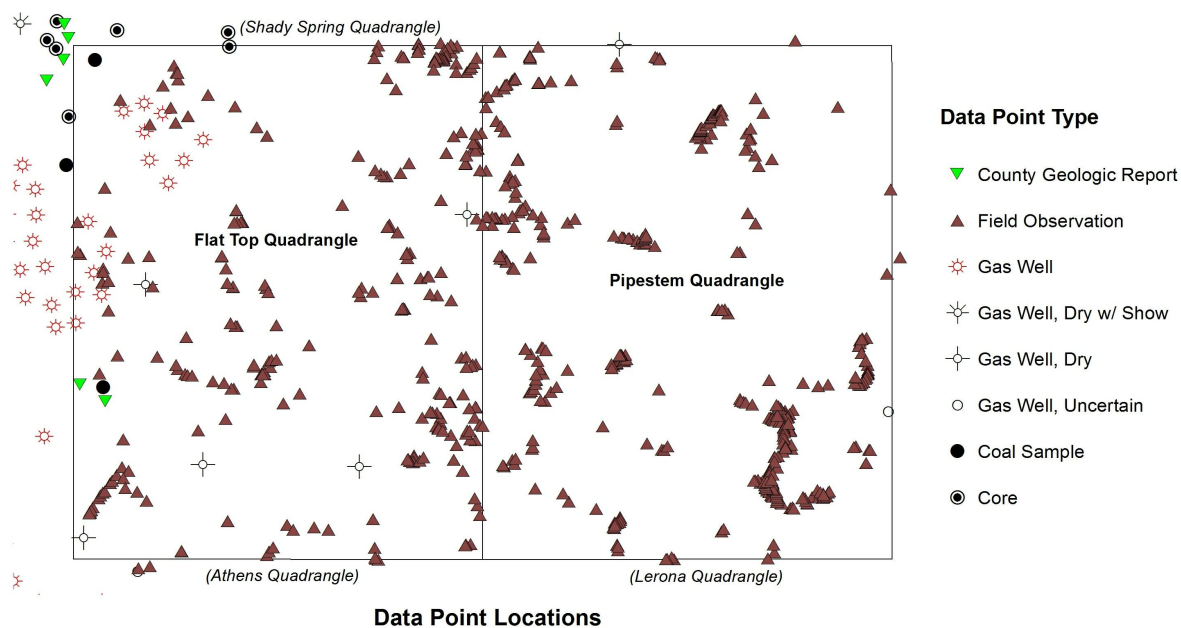
↕ Anticline, Plunging, Inferred

↕ Syncline, Inferred

▭ State and National Park Boundaries

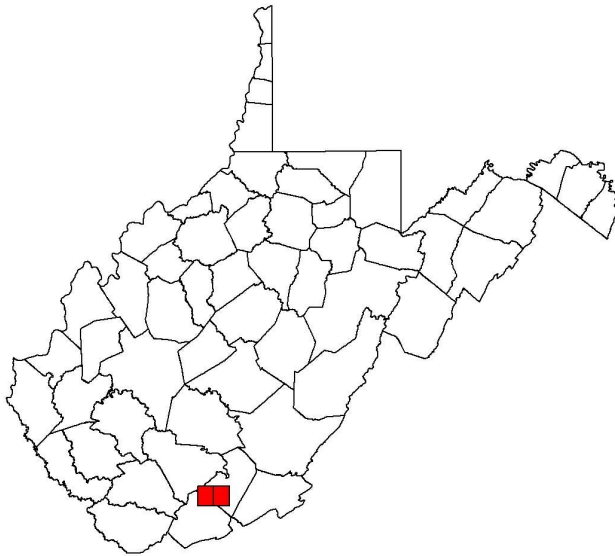
Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

Data Point Map



Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

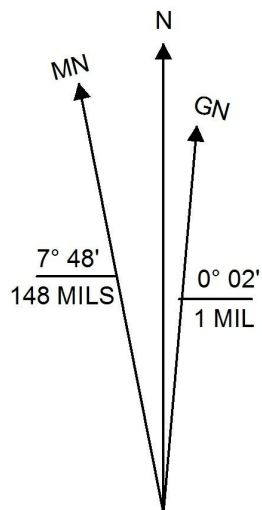
Location Map



Location Map

Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

Magnetic Declination



UTM GRID AND 2011 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

References

- Beeler, Hazel E., 1999, Terrestrial paleoecology of distal deltaic environments of the upper Mississippian Bluefield, Hinton and Bluestone formations of southwestern Virginia and southern West Virginia: Unpublished master's thesis, Virginia Polytechnic Institute and State University, 294 p.
- Beuthin, Jack D., 1997, Paleopedological evidence for a eustatic Mississippian-Pennsylvanian (mid-Carboniferous) unconformity in southern West Virginia: *Southeastern Geology*, v. 37, p. 25-37.
- Beuthin, Jack D. and Bascombe Mitch Blake, Jr., 2001, Bedrock Geologic Map of the Athens Quadrangle, West Virginia: West Virginia Geological Survey, Open-File Report 0104, 1 sheet, 1:24,000 scale.
- Beuthin, Jack D. and Bascombe Mitch Blake, Jr., 2002a, Bedrock Geologic Map of the Lerona Quadrangle, West Virginia-Virginia: West Virginia Geological Survey, Open-File Report 0205, 1 sheet, 1:24,000 scale.
- Beuthin, Jack D. and Bascombe Mitch Blake, Jr., 2002b, Scrutiny of a global climate model for Upper Mississippian depositional sequences in the central Appalachian foreland basin, U.S.A.: *The Journal of Geology*, v. 110, p. 739-747.
- Beuthin, Jack D. and Bascombe Mitch Blake, 2004, Revised stratigraphy and nomenclature for the Upper Hinton Formation (Upper Mississippian) based on recognition of regional marine zones, southern West Virginia: *Southeastern Geology*, v. 42, no. 3, p. 165-178.
- Beuthin, Jack D. and Donald W. Neal, 1998, Upper Mississippian paleosols as indicators of allocyclic and autocyclic events, southern West Virginia: Field trip guidebook, Southeastern Section, Geological Society of America, 16p.
- Beuthin, Jack D., Bascombe Mitch Blake, Jr., and Eugene Rader, 2000, Bedrock geologic map of the Bluefield quadrangle, West Virginia-Virginia: West Virginia Geological and Economic Survey Open File Report 0003, 1 sheet, 1:24000 scale.
- Blake, Jr., Bascombe Mitch, and Jack D. Beuthin, 2002, Bedrock geologic map of the Matoaka quadrangle, West Virginia: West Virginia Geological and Economic Survey Open File Report 0201, 1 sheet, 1:24000 scale.
- Blake, Bascombe Mitch, Jr., and Jack D. Beuthin, 2008, Deciphering the mid-Carboniferous eustatic event in the central Appalachian foreland basin, southern West Virginia, USA: in C.R. Fielding, T.D. Frank, and J.L. Isbell, eds., *Resolving the Late Paleozoic Ice Age in Time and Space*: Geological Society of America Special Paper 441, p. 249-260.
- Blake, Jr., Bascombe Mitch, Jack D. Beuthin, and Eugene Rader, 2000, Bedrock geologic map of the Princeton quadrangle, West Virginia-Virginia: West Virginia Geological and Economic Survey Open File Report 0004, 1 sheet, 1:24000 scale.
- Blake, Jr., Bascombe Mitch, Jack D. Beuthin, and Eugene Rader, 2001, Bedrock geologic map of the Oakvale quadrangle, West Virginia-Virginia: West Virginia Geological and Economic Survey Open File Report 0101, 1 sheet, 1:24000 scale.
- Campbell, Marius R., 1896, Description of the Pocahontas quadrangle of Virginia and West Virginia: U. S. Geological Survey Geological Atlas, Folio 26, 7 p., 5 maps.
- Cardwell, Dudley H., and Katharine Lee Avary, 1982, Oil and Gas Fields of West Virginia: West Virginia Geological and Economic Survey, Mineral Resources Series, No. MRS-7B, 190 p.
- Cooper, Byron N., 1948, Status of Mississippian stratigraphy in the central and northern Appalachian region: *The Journal of Geology*, v. 56, p. 255-263.
- Cooper, Byron N., 1961, Grand Appalachian Excursion: Virginia Polytechnic Institute Engineering Extension Series, Geological Guidebook I, Blacksburg, 187 p.
- Englund, Kenneth J., 1968, Geologic map of the Bramwell quadrangle, West Virginia-Virginia: U. S. Geological Survey Map GQ-745, 1 sheet, 1:24,000 scale.
- Englund, Kenneth J., 1979, Mississippian System and Lower Series of the Pennsylvanian System in the proposed Pennsylvanian System stratotype area: in K.J. Englund, H.H. Arndt, and T.W. Henry, eds., *Proposed Pennsylvanian System Stratotype, Virginia and West Virginia*: American Geological Institute, Selected Guidebook Series No. 1, Guidebook for Ninth International Congress of Carboniferous Stratigraphy and Geology Field Trip No. 1, p. 69-72.

- Englund, Kenneth J. and Henry Randall III, 1981, Stratigraphy of the Upper Mississippian and Lower Pennsylvanian Series in the East-Central Appalachians: in T.G. Roberts, ed., Volume 1: Stratigraphy, sedimentology: GSA Cincinnati '81 Field Trip Guidebooks, American Geological Institute, p. 154-158.
- Henry, Thomas W. and Mackenzie Gordon, Jr., 1979, Late Devonian through Early Permian(?) invertebrate faunas in proposed Pennsylvanian System stratotype area: in K.J. Englund, H.H. Arndt, and T.W. Henry, eds., Proposed Pennsylvanian System Stratotype, Virginia and West Virginia: American Geological Institute, Selected Guidebook Series No. 1, Guidebook for Ninth International Congress of Carboniferous Stratigraphy and Geology Field Trip No. 1, p. 97-103.
- Henry, Thomas W. and Mackenzie Gordon, Jr., 1992, Middle and upper Chesterian brachiopod biostratigraphy, eastern Appalachians, Virginia and West Virginia: in P.K. Sutherland, and W.L. Manger, eds., Recent advances in Middle Carboniferous biostratigraphy – a symposium: Oklahoma Geological Survey Circular 94, p. 1-21.
- Hoare, Richard D., 1993, Mississippian (Chesterian) bivalves from the Pennsylvanian stratotype area in West Virginia and Virginia: Journal of Paleontology, v. 67, p. 374-396.
- Krebs, Charles E. and D. Dee Teets, Jr., 1916, Raleigh County and the western portions of Mercer and Summers Counties [West Virginia]: West Virginia Geological Survey [County Report], 778 p.
- Mack, Greg H., W. Calvin James, and H. Curtis Monger, 1993, Classification of paleosols: Geological Society of America Bulletin, v. 105, no. 2, p. 129-136.
- Meissner, Charles R., Jr., 1981, Geologic map of the Shady Spring quadrangle, Raleigh and Summers Counties, West Virginia: U.S. Geological Survey Geologic Quadrangle Map, GQ-1546, 1 sheet, 1:24,000 scale.
- Miller, Daniel J., and Kenneth A. Eriksson, 1997, Late Mississippian prodeltaic rhythmmites in the Appalachian Basin: a hierarchical record of tidal and climatic periodicities: Jour. Sedimentary Research, v. B67, p. 653-660.
- Miller, Daniel J., and Kenneth A. Eriksson, 1999, Linked sequence development and global climate change: the upper Mississippian record in the Appalachian basin: Geology, v. 27, p. 35-38.
- Miller, Daniel J., and Kenneth A. Eriksson, 2000, Sequence stratigraphy of Upper Mississippian strata in the central Appalachians: A record of glacioeustasy and tectonoeustasy in a foreland basin setting, A.A.P.G. Bulletin, v. 84, no. 2, p. 210-233.
- National Park Service, 2011, Whitewater: Bluestone National Scenic River: <http://www.nps.gov/blue/index.htm>, accessed November 15, 2011.
- Reger, David B., 1926, Mercer, Monroe, and Summers Counties [West Virginia]: West Virginia Geological Survey [County Report], 963 p.
- Schalla, Robert A., 1984, Deltaic deposits of the Upper Mississippian Ravenscliff member of the Hinton Formation, southern West Virginia: Southeastern Geology, v. 25, p. 1-12.
- Wrightstone, Gregory R., 1984, Ravenscliff becomes exploration target: Northeast Oil Reporter, v. 4, no. 8, p. 31-41.
- Wrightstone, Gregory R., 1985, The stratigraphy and depositional environment of the Ravenscliff Formation in McDowell and Wyoming Counties, West Virginia: Unpublished master's thesis, West Virginia University, 98 p.
- Sullivan, Walter A., 2001, Stratigraphy of Upper Hinton Formation sandstones in the Bluestone River Gorge, southern West Virginia: GSA Abstracts with Programs, v. 33, no. 2, p. 77.
- West Virginia Division of Natural Resources, 2011a, Bluestone State Park: <http://www.bluestonesp.com>, accessed November 13, 2011.
- West Virginia Division of Natural Resources, 2011b, Pipestem Resort State Park: <http://www.pipestemresort.com>, accessed November 13, 2011.
- West Virginia Division of Natural Resources, 2011c, Bluestone Wildlife Management Area: <http://www.bluestonewma.com>, accessed November 13, 2011.
- West Virginia Division of Natural Resources, 2011d, Camp Creek State Park, <http://www.campcreekstatepark.com>, accessed November 15, 2011.
- West Virginia Geological and Economic Survey, 2011a, Interactive Coal Maps-All Coals: http://ims.wvgs.wvnet.edu/all_coal/viewer.htm, accessed August 27, 2010.

West Virginia Geological and Economic Survey, 2011b, Interactive Coal Maps-New River (Fm): <http://ims.wvgs.wvnet.edu/fck/viewer.htm>, accessed November 13, 2011.

West Virginia Geological and Economic Survey, 2011c, Interactive Coal Maps-Pocahontas Formation (Fm): http://ims.wvgs.wvnet.edu/Fm_Pocahontas/viewer.htm, accessed November 13, 2011.

West Virginia Geological and Economic Survey, 2011d, Interactive Oil and Gas Maps-"Pipeline-Plus": <http://ims.wvgs.wvnet.edu/WVOG/viewer.htm>, accessed November 16, 2011.

Extracted from: (GRI Source Map 75598) ([Open File Report 1101](#)).

County Geologic Report

The six features in the Geologic Observation Localities feature class are from County Geologic Report No. 81, pages 504, 507 and 622. The location IDs include the report number, page number and which paragraph (A-F) on that page the description is located. The relevant text from three pages of the report that relate to this dataset are provided below. The full report, Raleigh County and the Western Portions of Mercer and Summer Counties, is available on Google Books [here](#).

Very little Sewell Coal is found in Shady Spring District, there being small disconnected patches in the western and southern parts of the same. A few sections were measured, as follows :

081-504A

Price Heirs Local Fuel Opening—No. 402 on Map II.

One mile almost due west, of Ghent; Sewell Coal; elevation, 3025' B.; section by Teets; butts, N. 25° W.; faces, N. 65° E.; greatest rise, southeast.

			Ft.	In.
Coal, gas (with slate roof)	2'	2"		
Shale, gray	1'	7"		
Coal (to slate floor)	1'	1"	4	10

081-504B

Fink Local Fuel Opening—No. 403 on Map II.

On the waters of Oak Creek of Glade Creek, 1.0 mile northwest of Ghent; Sewell Coal; elevation, 3070' B.; butts, N. 25° W.; faces, N. 65° E.; section by Krebs.

			Ft.	In.
Coal, gas (with slate roof)	2'	2"		
Shale, gray	0'	11"		
Coal, gas (to slate floor)	1'	1"	4	2

081-504C

Glade Creek & Raleigh R. R. Co. Local Fuel Opening—No. 404 on Map II.

On waters of Oak Creek of Glade Creek, one mile northwest of Ghent; Sewell Coal; elevation, 3080' B.; section by Teets.

			Ft.	In.
Coal (with shale roof and slate floor)	2'	9"	2	9

081-507F

Coal Exposure—No. 414 on Map II.

In county road, 0.7 mile northwest of Ghent; Little Raleigh Coal; elevation, 2960' B.; section by Teets.

			Ft.	In.
Coal (with shale roof and slate floor)	1'	0"	1	0

081-622D

Coal Exposure—No. 703 on Map II.

In county road, 0.7 mile south of Fairview School; No. 3 Pocahontas Coal; elevation, 2780' B.; section by Teets.

			Ft.	In.
Coal (with shale roof and slate floor)	1'	6"	1	6

081-622E

Ed. Lilly Prospect—No. 704 on Map II.

On west side of road leading to Bear Creek, 0.5 mile southwest of Fairview School; No. 3 Pocahontas Coal; elevation, 2750' B.; section by Krebs.

			Ft.	In.
Dark shale (with sandstone cover)	1'			
Coal, soft	1'	6"		
Concealed by water	1'	0"	2	6

Provided by: Paula Hunt, Geologist, West Virginia Geological and Economic Survey (WVGES)

Cores and Coal Samples

Cores were used to identify coal or other marker beds at depth so they maybe more than one geologic unit related with these point locations.

Coal Samples were collected by the West Virginia Geological and Economic Survey (WVGES) in the late 1970s at of near the land surface (approximately between 3 to 10 feet below). The ID numbers associated with these features refers to the notebook number and page number. For example, "27-011" would be coal notebook 27, page 11. The public is invited to go to the WVGES office to view the notebooks.

Provided by: Paula Hunt, Geologist, West Virginia Geological and Economic Survey (WVGES)

GRI Digital Data Credits

This document was developed and completed by Andrea Croskrey (NPS GRD) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Jim Chappell (Colorado State University).

The information contained here was compiled to accompany the digital geologic-GIS map(s) and other digital data for Bluestone National Scenic River, West Virginia (BLUE) developed by Andrea Croskrey and Jim Chappell (NPS GRD and Colorado State University).

GRI finalization by Stephanie O'Meara (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).